FLUKE® Reliability

Best practice guide to condition monitoring and vibration analysis

Colin Pickett

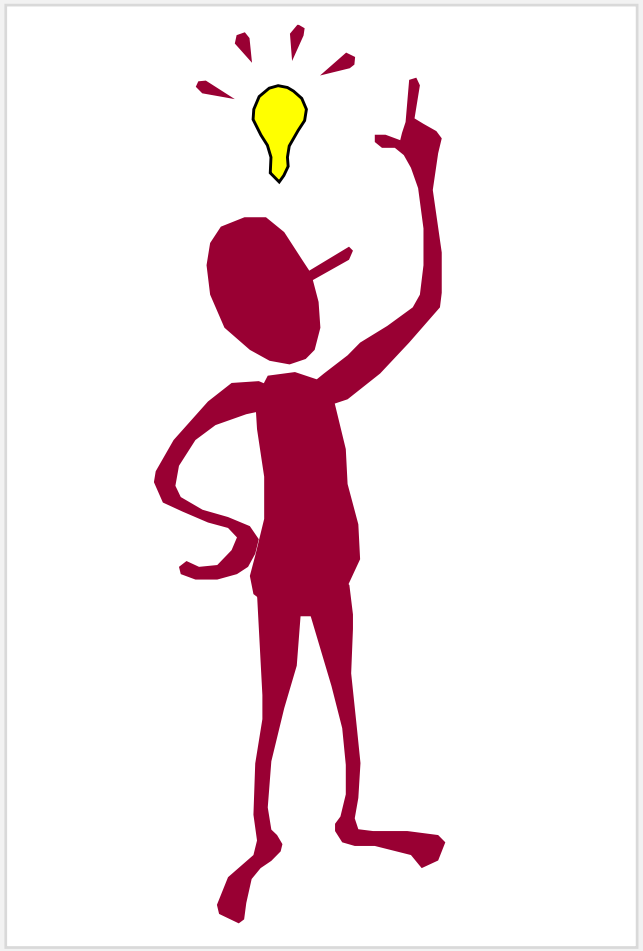
Accelix™
Webinar Series

Colin Pickett

Consultant, Pruftechnik technologies
Fluke Reliability

- 35+ years of reliability / vibration experience
- Mobius ISO VA CAT III
- Mobius and Pruftechnik approved trainer
- 9 years with Pruftechnik UK Ltd.
- 4 years working with Pruftechnik Americas
- Owner/operator of VCMR – Vibration Condition Monitoring & Reliability

More to think about



CONDITION MONITORING AND VIBRATION ANALYSIS:

A guide to pickin’ up good vibrations,
“My” Best Practice guide

More to think about

Vibration Analysis is NOT Condition Monitoring!

Condition Monitoring is NOT Vibration Analysis!

- Condition-based monitoring is regularly checking the condition of your machines and looking for changes in the data collected.

- Vibration analysis is the *analytical* method of looking for and identifying the machine's faults in the vibration data.

- Today’s fast and powerful vibration tools can allow us to collect both condition monitoring and vibration analysis data.

POLL QUESTION No. 1

Do you perform condition monitoring and vibration analysis at your site?

(Click only one answer)

- Yes, we have an in-house team
- Yes, we have a contract company
- No, but we are actively planning to do CM and VA
- No, but we may do CM and VA at some point
- Not sure

FLUKE Reliability

More to think about

One problem facing the vibration analyst is this decision:

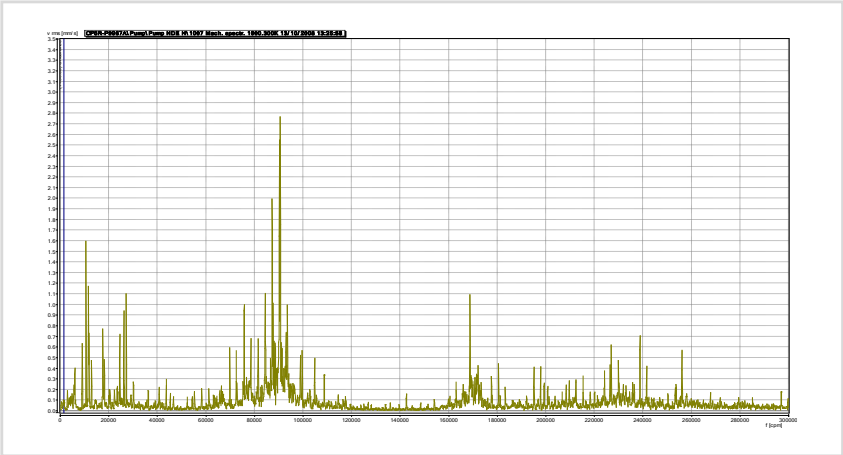
- Is the machine “worth” checking and what type, and how much data is needed to identify any machinery faults?
- Do a criticality study to find out if the machine is “critical.”

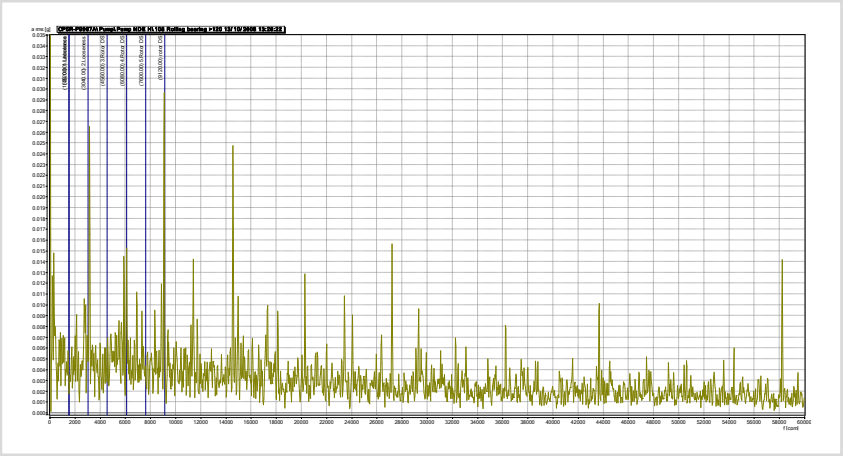
Often, some of the basic steps are overlooked, and a key element to the analysis is missing.

CONFIRM THE RUNNING SPEED!!!!!

More to think about

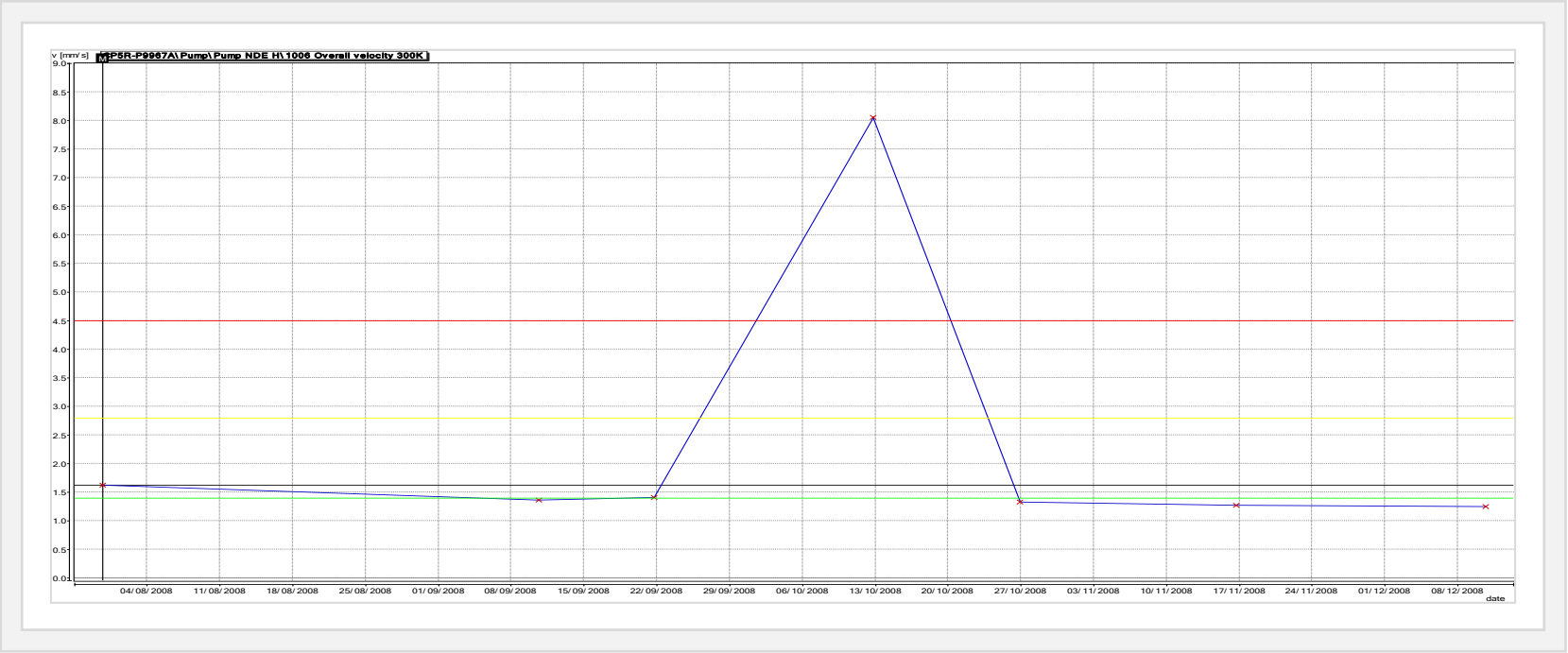
- The type of data and the amount of data will vary from one machine type to another.
- Because of this variation, it would be difficult to pre-think ***all*** the data that needs to be collected.
- To take advantage of all the measurement capabilities available, the vibration analyst should have a good knowledge of the machines and the types of data that can be collected from them.





More to think about

- The periodic collection of vibration data on a prescribed route should be treated as an indicator of possible problems.
- Any alarm “exceptions” should have more analysis done. That said, it means any alarms should be accurate. You don’t want false alarms and waste time on machines that are “normal.”



More to think about

- Some vibration problems can be easily diagnosed with a minimum of data while other require considerable time and effort in data collection and analysis.
- To get to the solution as efficiently as possible, the analyst needs to know "if" and "what type" of additional data is needed to solve the problem.

Quite an obvious failure

But what caused it?

And could it have been prevented?

POLL QUESTION No. 2

Do you keep a record of machine failures?

(Click only one answer)

- Yes, every failure
- Yes, some failures
- Yes, but critical machine failures only
- No, it’s too hard!

FLUKE Reliability

Condition monitoring principles

Condition monitoring principles

Detection

Trending a machines vibration level to detect and quantify any changes from the norm

Analysis

When a *significant* change is detected the data is analysed to determine the nature of the problem

Correction

The advanced warning provided by the detection and analysis enables corrective action to be prepared and scheduled

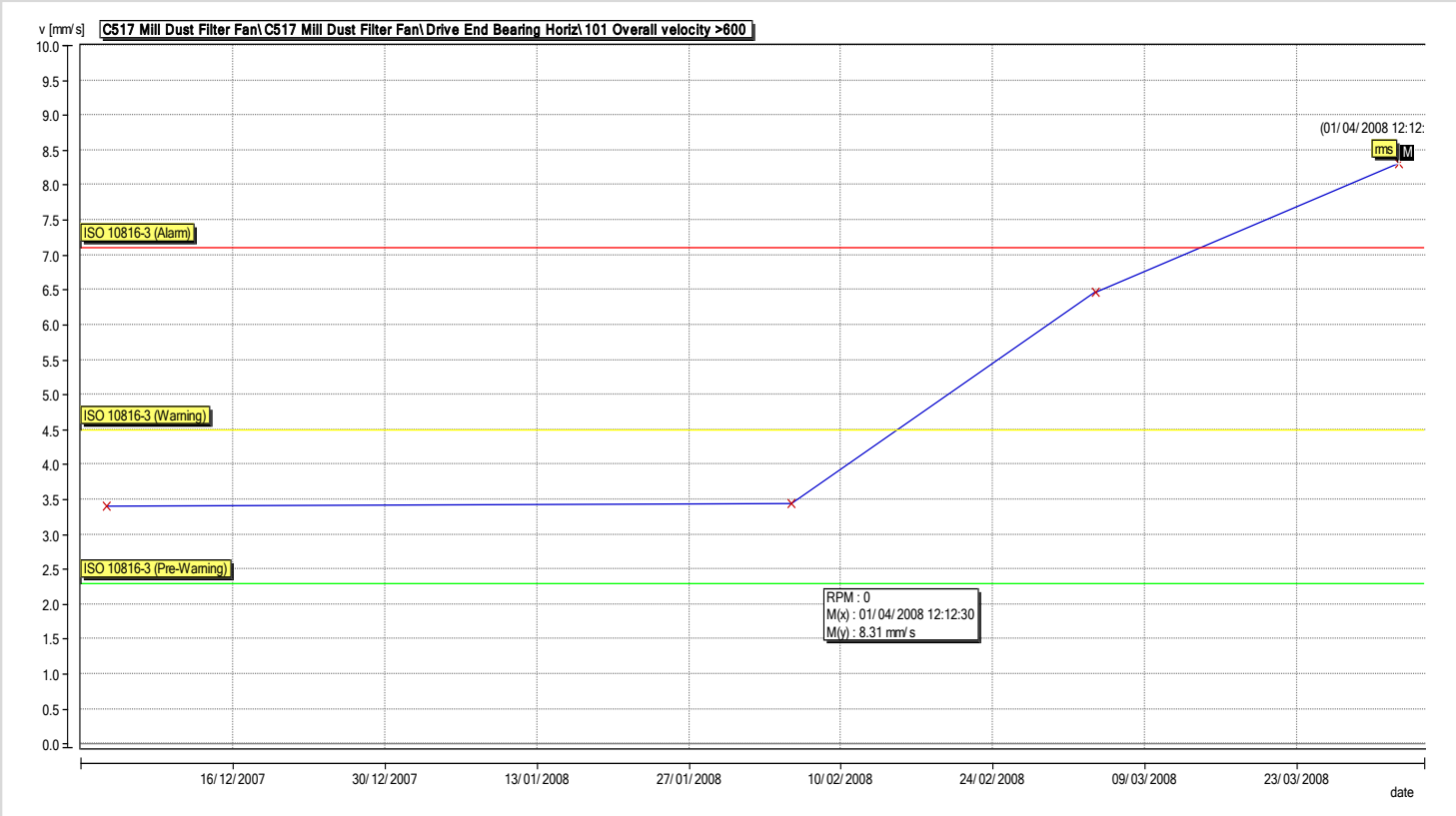
Verification

After correction new readings are obtained to ensure that all defects have been eliminated and to establish new baseline characteristics

Detection

The overall measurements are a summation of the total vibration acting in a particular direction at a given instance in time.

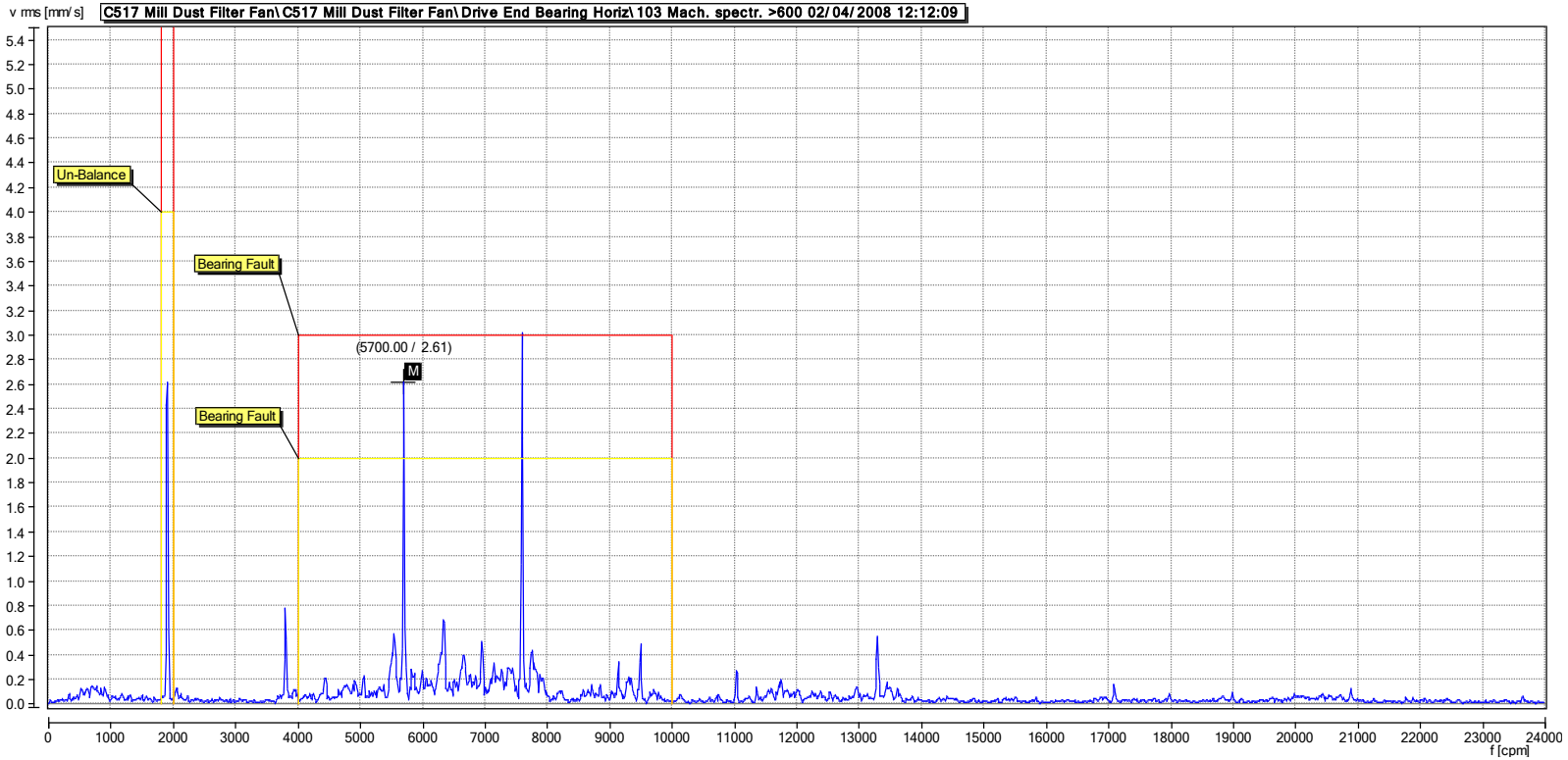
These are plotted on a “Trend” and any change in the levels can be easily identified.



Analysis

Having identified that a problem exists, the next step is to identify the specific problem, or problems, for correction.

This can be performed is through vibration spectral analysis.



Spectral analysis

Involves the processing of the analogue vibration signal through a digital converter and then through F.F.T. circuitry. This allows us to see specific amplitudes at the individual frequencies which can identify any machinery problems.

If you collect the correct data you will see the machines faults in the spectra.

- Peaks at 1x – Unbalance
- Peaks at 2x and or 3x – Misalignment
- Peaks at Line Frequency and 2x Line frequency – Electrical problems
- Non-Synchronous peaks – Bearing fault frequencies

Correction

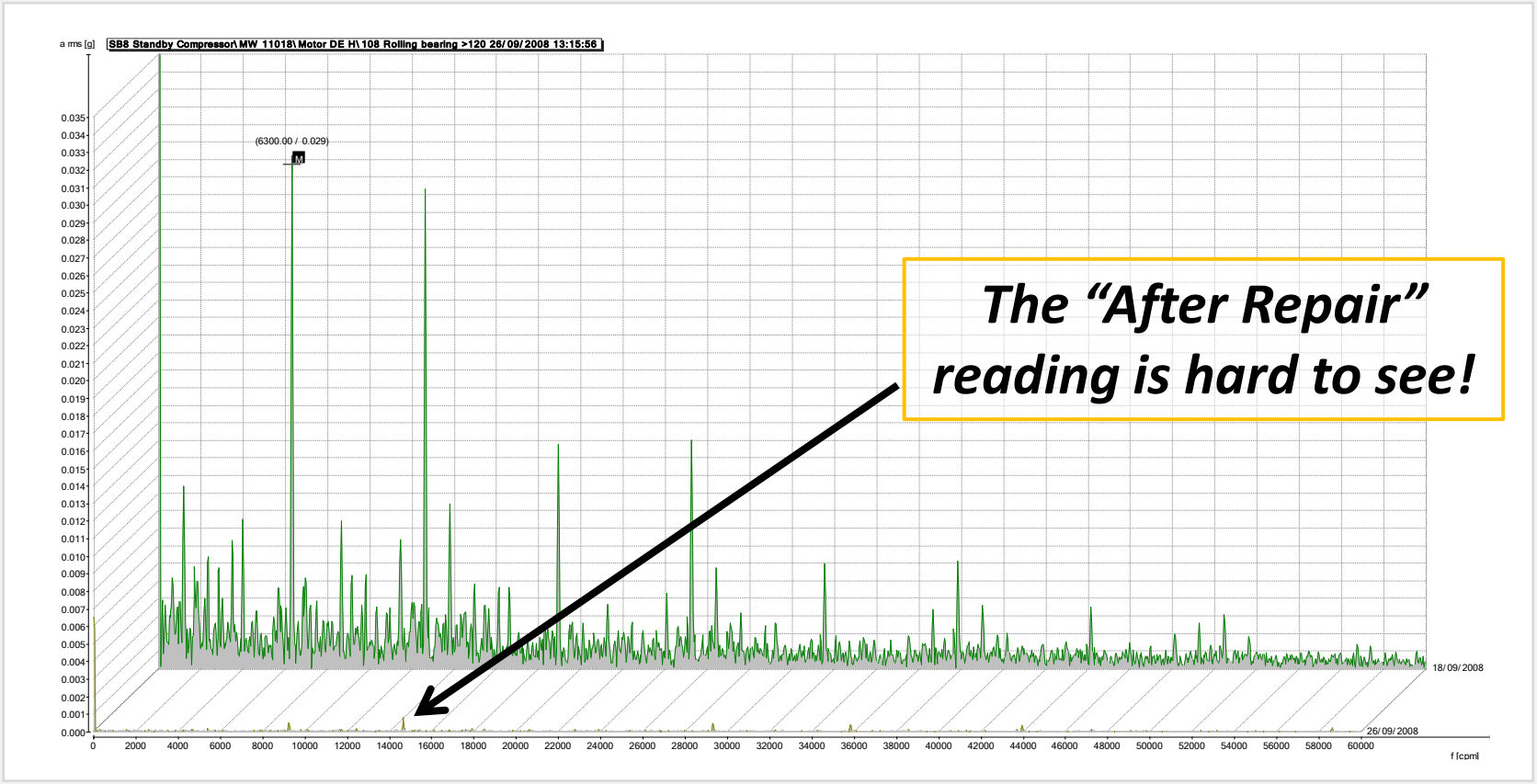
The advanced warning provided by the detection and analysis enables corrective action to be prepared and scheduled.

It is at this point that all the necessary equipment including any special requirements for repair personnel, replacement parts and tools can be arranged in advance.

This will ensure that the machine repair is carried out effectively and that the total downtime is kept to an absolute minimum.

Verification

After any correction work, new readings should be obtained to ensure that all defects have been eliminated and to establish new baseline characteristics.



FLUKE Reliability

When you suspect you have an issue

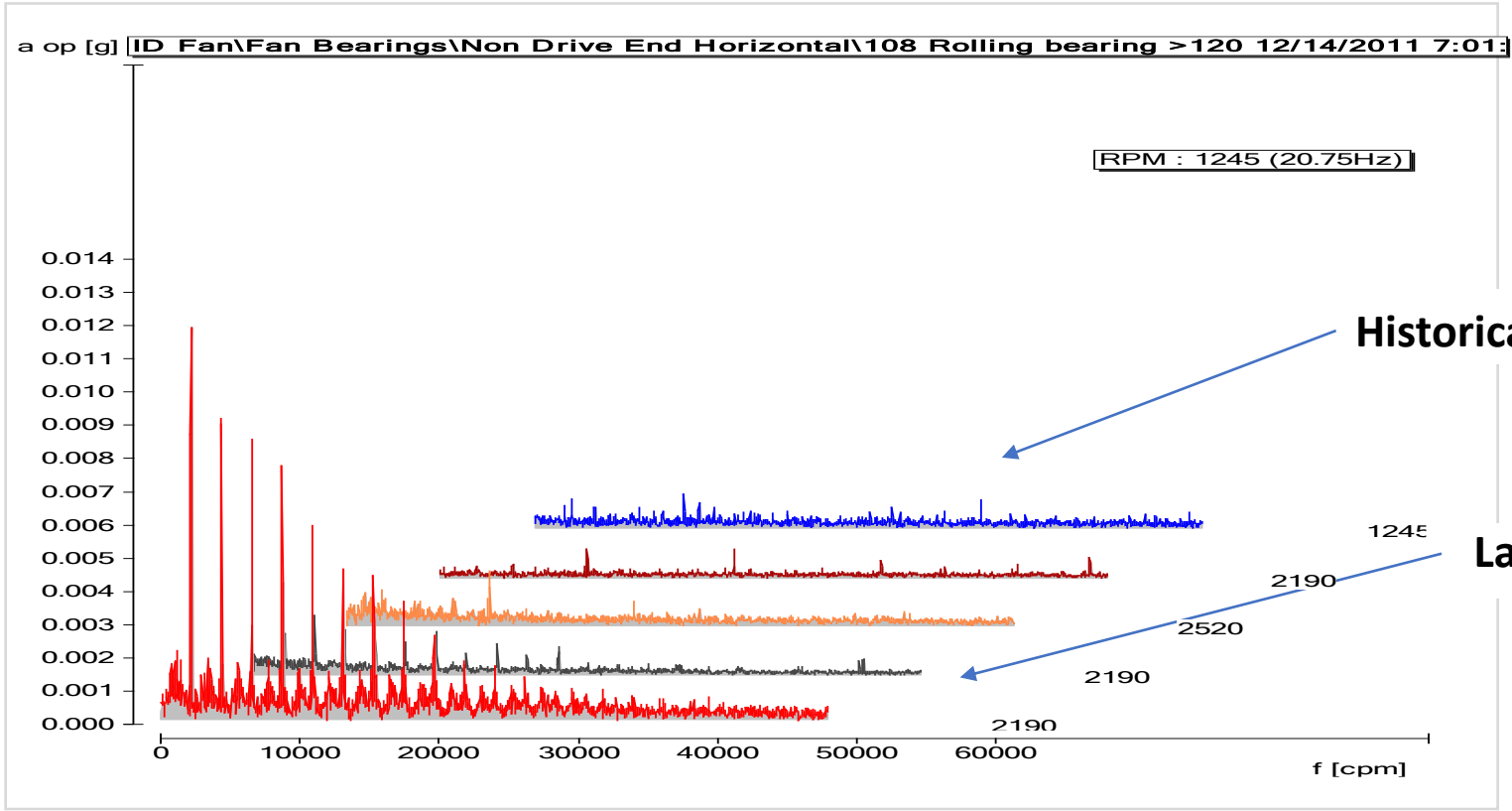
Any alarm exceptions will need investigating. Some are easily sorted, i.e., unbalance, misalignment, and some need more detective work …

… the following is ***my*** Guide to Best Practice for Condition Monitoring & Vibration Analysis which may help to improve your Vibration Condition Based Monitoring effort.

Look at the machine’s history

Closely tied to defining any problem is the need to check the machine's history. If the machine is one you work around every day, you may be aware of the changes occurring in the operating conditions.

Experience has shown that the machine operator and maintenance personnel who work with the machine every day often provide a good insight to any changes in the machine.



FLUKE Reliability

Questions to ask

When did the problem start?

- Was there a sudden increase in vibration?
- Was there a gradual increase in vibration?
- Did the machine always run rough?
- Did the machine ever run acceptably?
- Has there ever been a change in the performance expectations in this machine due to new process requirements?

Questions to ask

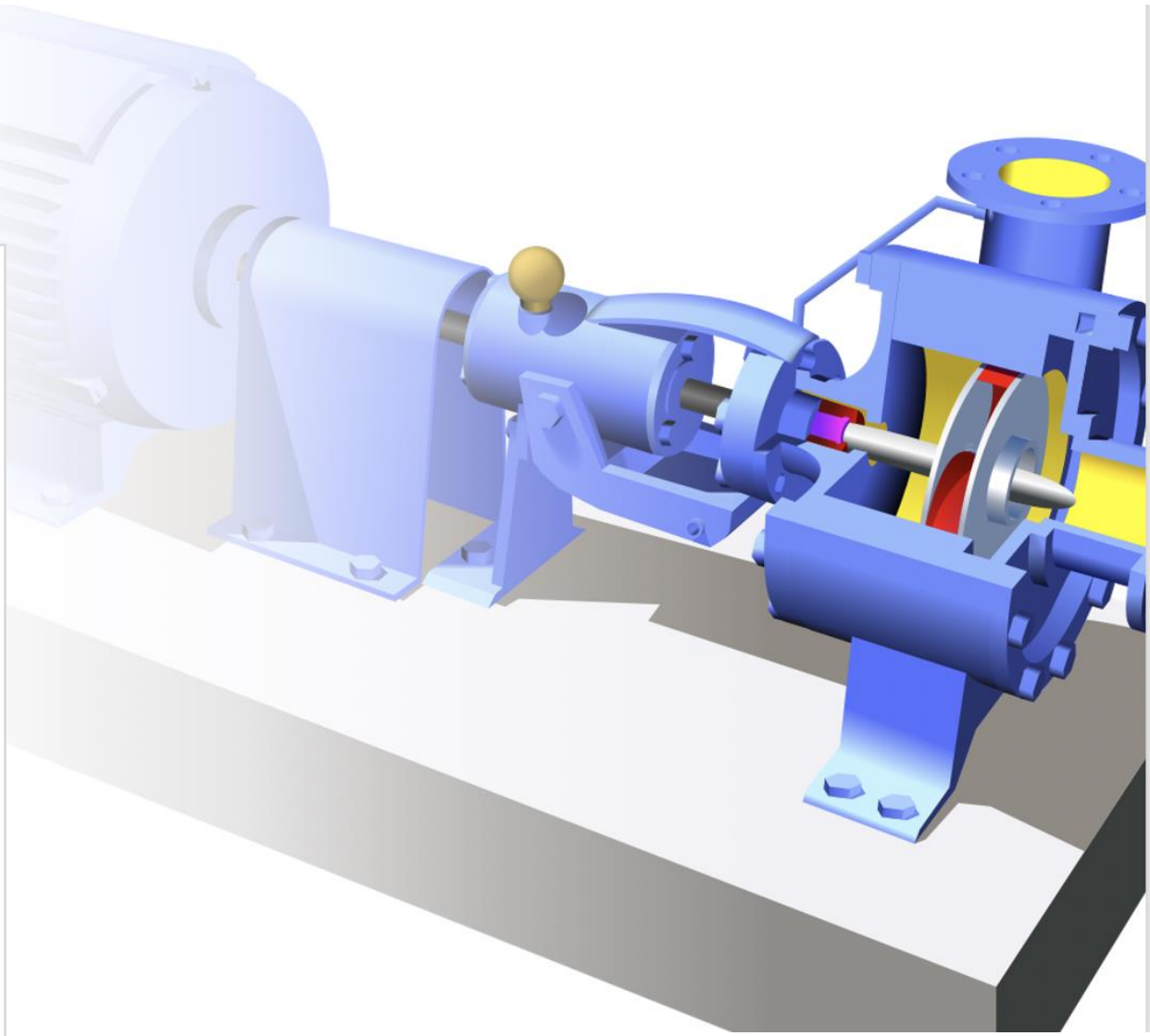
Have any changes been made recently?

- Modifications?
- Structural?
- Repairs?
- New machines in the area?
- Electrical changes?
- Sheave or gearbox changes?
- Changes in machine load or change in product?
- Changes in machine speed?

CONFIRM RUNNING THE SPEED!!!

Get the machine details

- One of the most influential steps to accurate determination of machine's problems is to pay close attention to the machine's physical makeup.
- Machine details can include a digital image of the machine or a sketch with measurement locations noted and accurate input and output speeds.
- Operating conditions at the time of analysis should also be recorded.

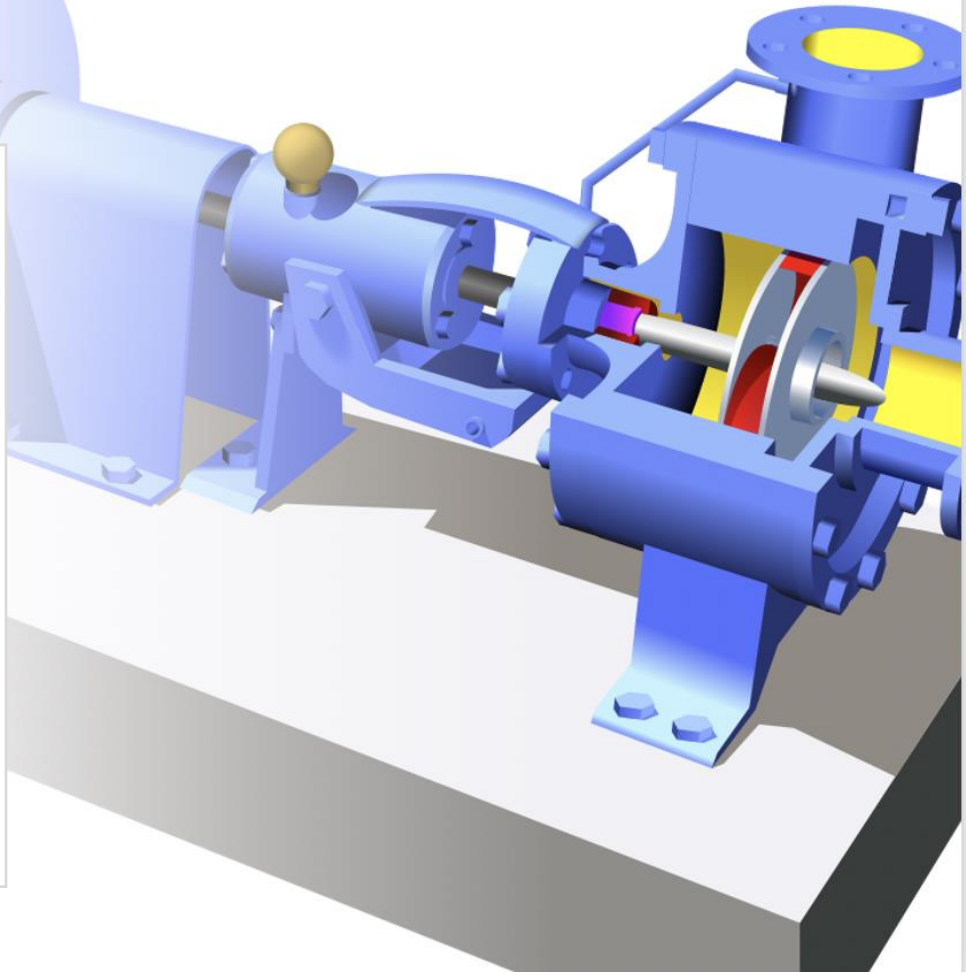


CONFIRM RUNNING THE SPEED!!!

Get the machine details

- A widely accepted method of measurement identification is to start with the outboard bearing of the driver (motor, diesel engine, steam turbine, etc.) and identify this as Bearing #1 or Motor Non Drive End and don't forget the direction of data collection H V A.

- Work through the drive train until you reach the outermost bearing of the driven unit (pump, fan, generator, etc.) advancing the bearing number or designation for each Measurement location.



CONFIRM RUNNING THE SPEED!!!

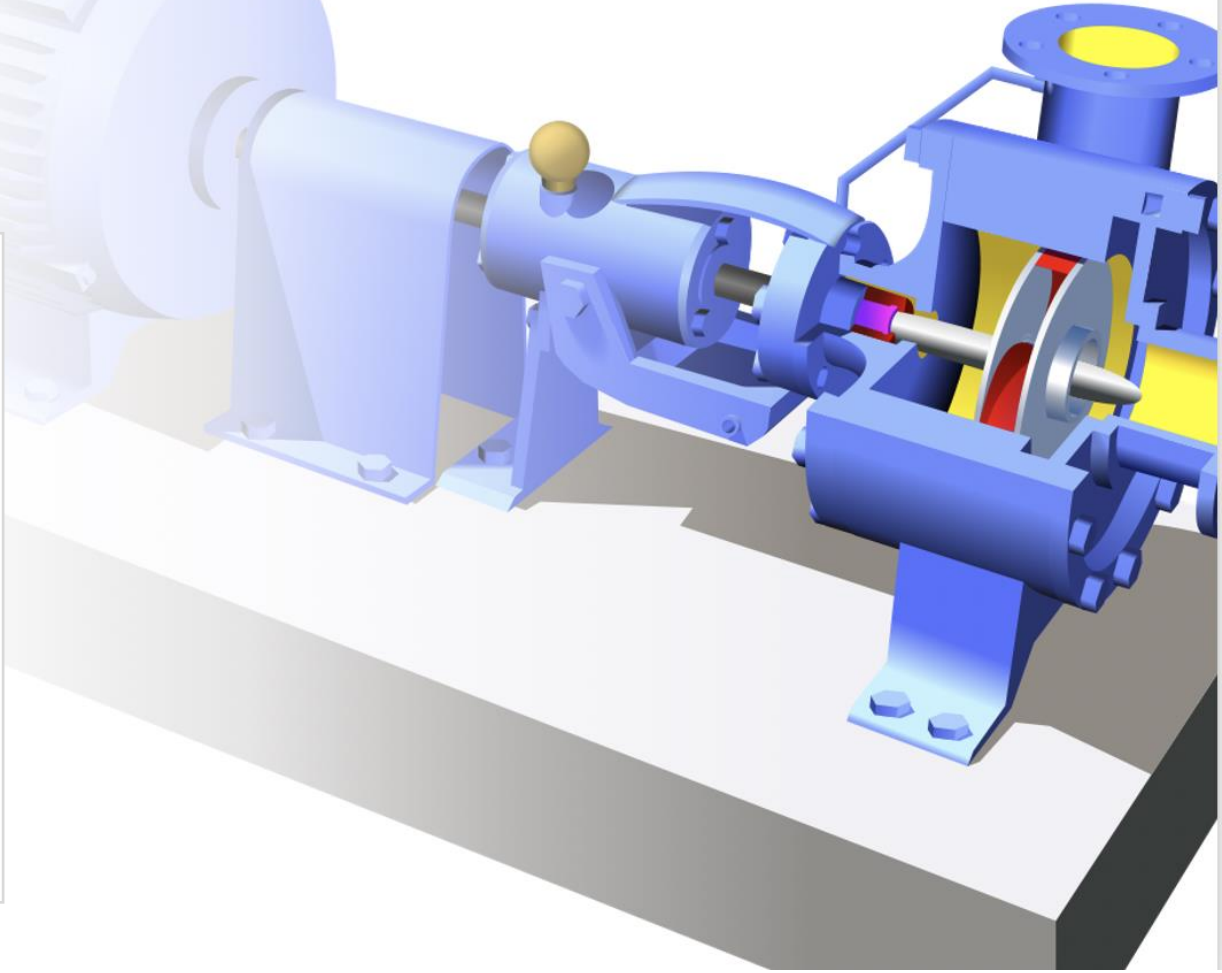
Get the machine details

The machine pictures and machine details should include several things that could provide any clue to the source of future problems.

Best practice would be to have this information ***before*** collecting any data, so that the criticality of the machine and the best measurement setups for the type, speed or load of the machine are known.

Make a visual inspection of the machine

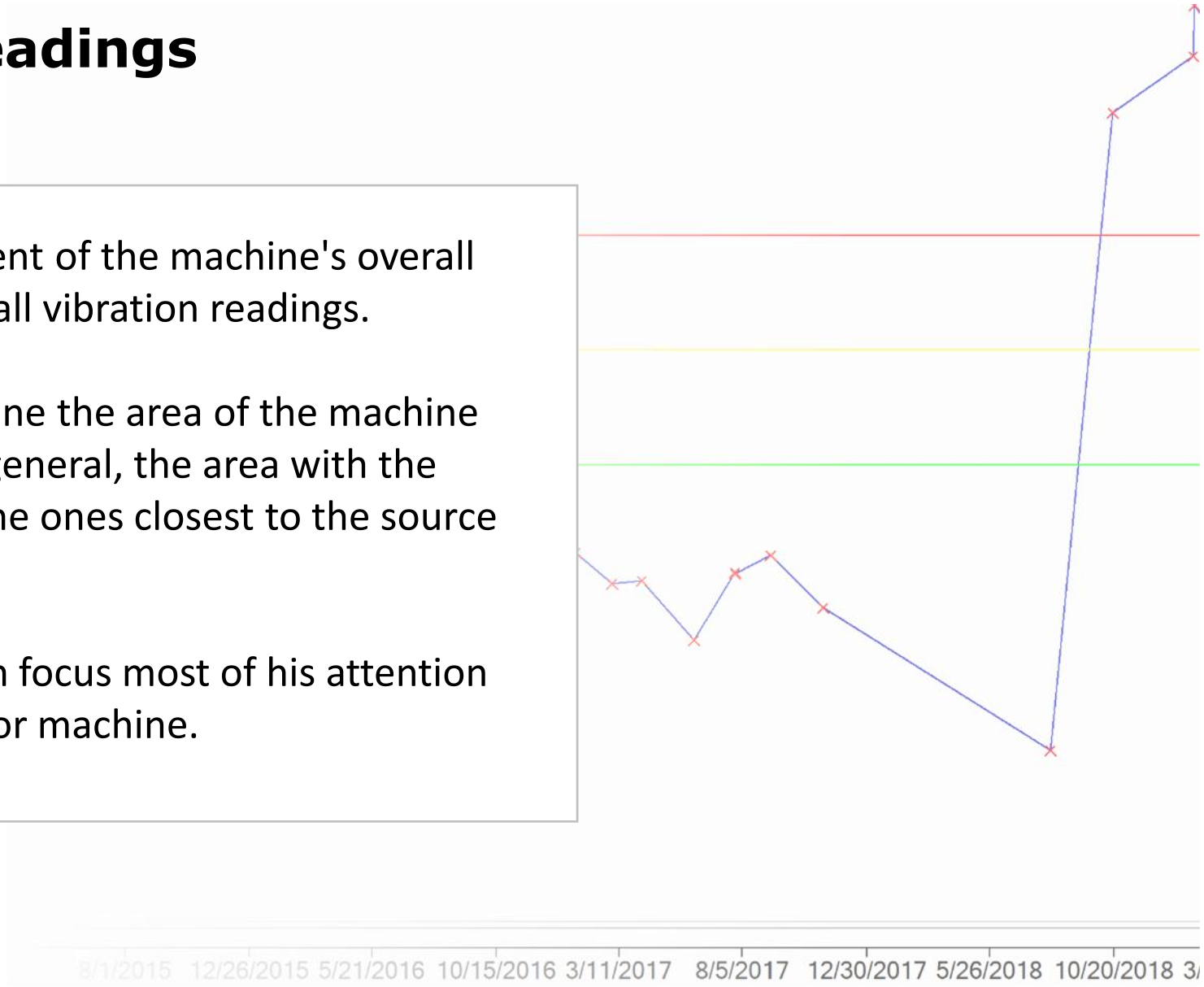
- ***Before*** collecting data on a machine, a visual check should be done to determine if there are any obvious faults or defects that could contribute to the machines current condition.
- Look for any loose, worn, or broken parts, leaking seals, foundation / structure cracks, and excessive lubrication issues.



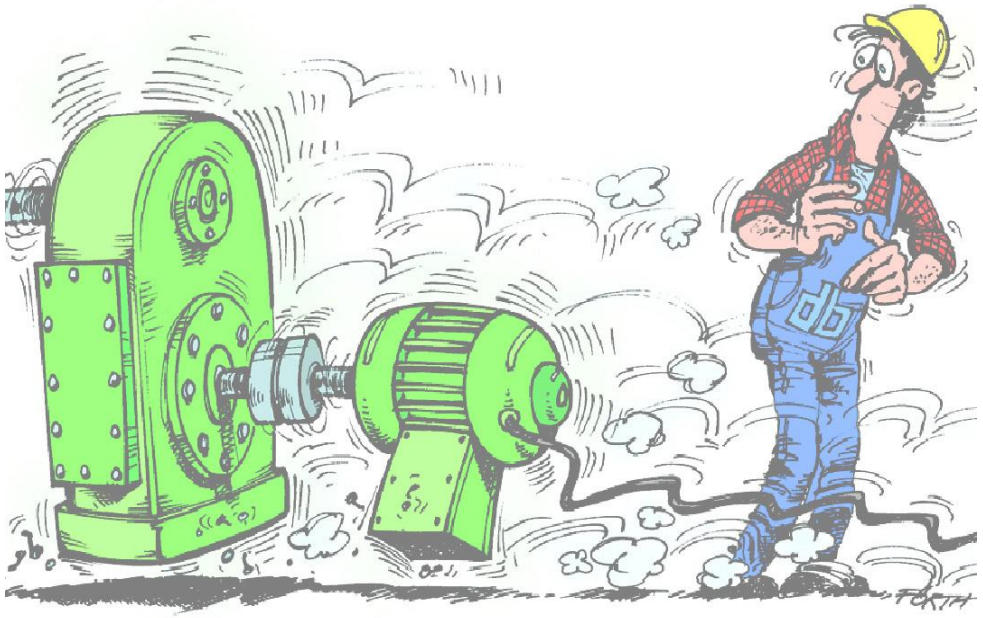
CONFIRM RUNNING THE SPEED!!!

Collect overall velocity readings

- Take the time to do a quick assessment of the machine's overall condition by taking an series of overall vibration readings.
- This will allow the analyst to determine the area of the machine with the highest vibration levels, in general, the area with the highest vibration levels are usually the ones closest to the source of the problem.
- When time is limited, the analyst can focus most of his attention on the just suspected problem area or machine.



Collect overall bearing condition measurements



- Bearing condition measurements, such as Shock Pulse or another form of Acceleration HFD -- these readings should be made on all rolling element bearings.
- Bearing condition readings can help focus attention or quickly eliminate the bearings as an issue.

H,V,A data at all positions

- Best practice says: Collect vibration spectrum data (velocity, acceleration, envelope, and even displacement*) in each plane (H, V, & A) and at each bearing point to provide a complete "picture" of the frequencies and vibration amplitudes affecting the machine.
- If the machine running time is limited, focus most of the data collection at the bearing points that displayed the highest overall vibration readings. Does the vibration tool have a recording function?

Label the data correctly!

*if required – slow speed

The correct setups - Spectra

- Route-based condition monitoring spectral data is usually optimised for speed, this may mean the frequency fmax and the lines of resolution of the spectra are not correct for accurate vibration analysis.
- Select the correct frequency range and resolution needed to accurately identify all the vibration frequencies.
- If the machine does not run under a constant load or speed, check the machine at different speeds and under different loads to determine changes in vibration amplitudes and frequencies.

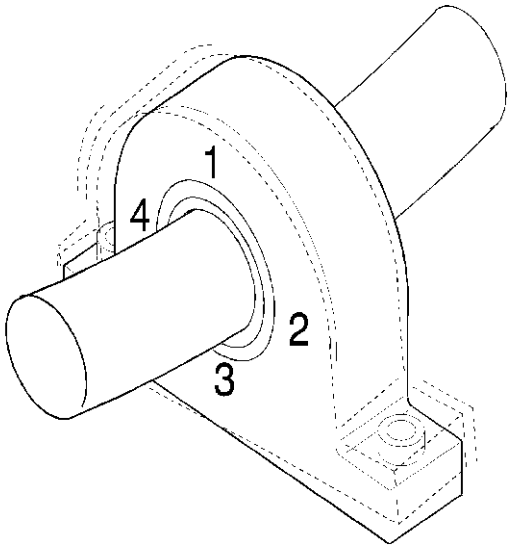
Phase – the forgotten parameter

Phase – the forgotten parameter

The one vibration parameter that is often overlooked is Phase. **Phase is essential for differentiating a number of vibration problems including imbalance, foundation issues, misalignment, and even bent shafts.**

- The analyst should record this phase information to help in the diagnosis.
- The exact number of degrees is generally not needed for evaluation of vibration problems. (+/- 30° is usually allowed)
- Using a clock face drawing at each measurement point on the bearing face would be adequate for finding a fault. (In this case, a possible bent shaft.)

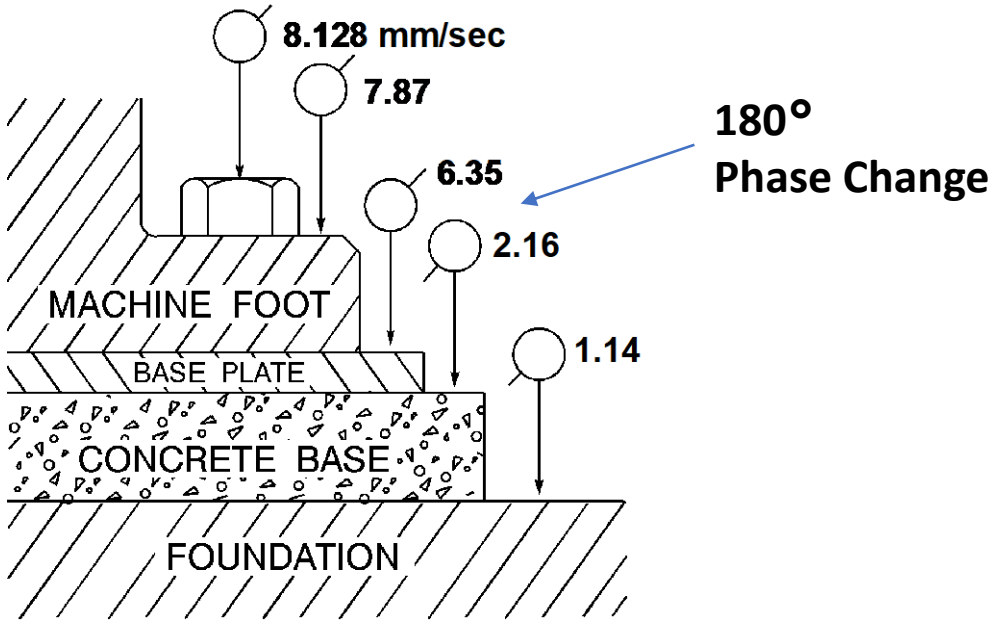
PHASE	
1	60°
2	150°
3	240°
4	330°



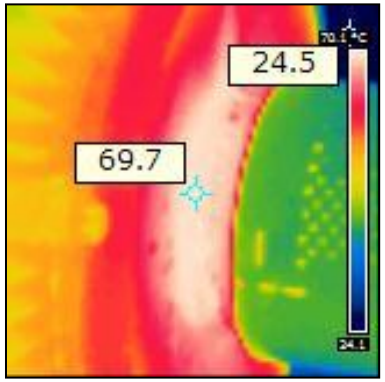
Phase – the forgotten parameter

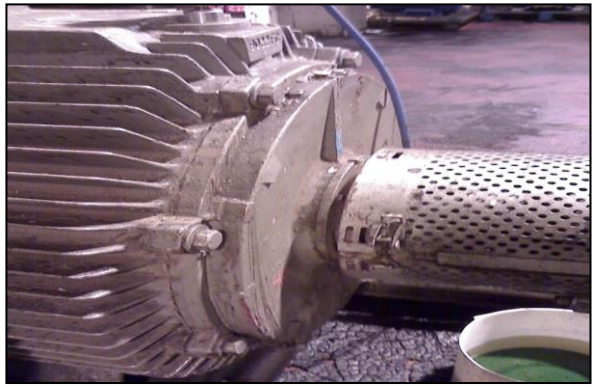
Phase readings can also be checked at each machine mounting point.

- A quick check of the mounting bolts, mounting foot, base plate, and foundation should all indicate approximately the same phase angle.
- When the phase varies by approximately 180° a foundation weakness or soft foot condition is usually the cause.



Recap – the basics





Confirm the running speed!

- Collect overall velocity readings.
- Collect overall bearing condition measurements.
- Check vibration levels at points other than the bearings: base, foundation, mounting feet,
- background or floor vibrations.
- If possible take temperature readings or thermal images.
- Take the correct spectral measurements – set the correct fmax and LOR
- Have a good look around the machine – is there debris below the coupling or belts?
- Are there any oil/grease leaks?
- Any unusual noises or smells?

Show off your successes

- When you are successful with your analysis, keep records and show off your findings. Some people often think that condition monitoring / vibration analysis is just a fancy screwdriver, so it can be rewarding show them it is more than that.
- Try to work out cost savings for the finds you have. It may cost $X to change a bearing, but what could be the cost of catastrophic failure? It's usually a lot more!!

Questions

QUESTIONS?

Thank you!

Colin Pickett
Colin.Pickett@pruftechnik.com
Consultant, PRUFTECHNIK, Fluke Reliability

Next webinar: Interactive asset mapping: The benefits of spatial intelligence

BEST PRACTICE WEBINAR

Wednesday, Dec. 2, 11 a.m. ET

Interactive asset mapping in your CMMS: The benefits of spatial intelligence

Spatial Intelligence is the human ability to visualize with the mind's eye. Reality capture technology allows us to add a digital version of the mind's eye to our maintenance process and asset management tools. Imagine a world where you can find each asset at your fingertips, ensuring all your decisions, as well as your system analytics, are based on accurate documentation.

Join **Emad Jooghi** and **Sebastian Schuster** of NavVis and **Conner Rivard** of Fluke Reliability. They'll provide a virtual representation of how your factory floor and integration with CMMS software can result in significant time and cost savings.

Emad Jooghi

Conner Rivard

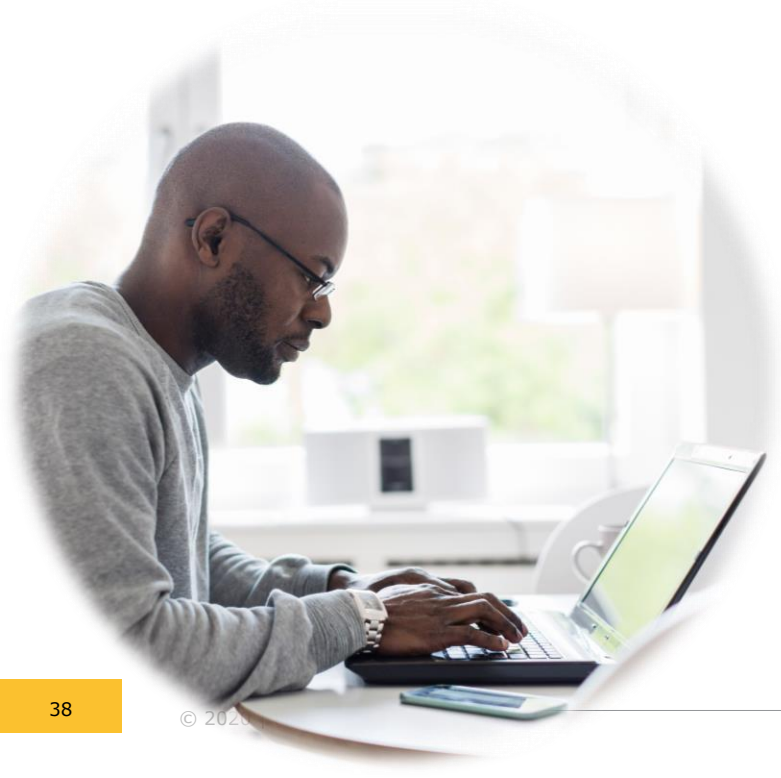
Sebastian Schuster

FLUKE Reliability

XCELERATE«20

We've gone virtual!

Our commitment to bringing you solutions that offer agility and structure in this climate of chaos continue, just in a different format.



Date: Nov. 17-19, 2020

Place: Where you are!

Website: https://xcelerate.accelix.com/

Xcelerate20 Virtual is your source for premium maintenance and reliability training, innovation and education. Join fellow maintenance professionals working toward improved reliability.

Watch your inbox for more details in the coming days, you won't want to miss it!

To learn more about Accelix and our Webinar Series

SURVEY

Please provide feedback on this webinar by responding to our survey. Do you want a Certificate of Attendance?

WEBINAR SERIES

Visit this page to learn more about our Webinar Series: https://www.accelix.com/community/best-practice-webinars/

DEMO

Visit Accelix.com for a free demo of our Connected Reliability Framework.

FLUKE Reliability

FLUKE®
Reliability

THANK YOU!

www.fluke.com 1-800-850-4608

sales@accelix.com

Accelix™